



ELECTRICAL
& COMPUTER
ENGINEERING

ECE-595 Network Softwarization

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Introduction

A distinct key feature of the 5G system architecture is **network slicing**.

- In the previous generation, only light functionality for dedicated Core Networks.
- 5G network slicing is a much more powerful concept and includes the whole PLMN.

Network slicing allows for controlled composition of a PLMN from the specified network functions with their specifics and provided services that are required for a specific usage scenario.

Introduction

Earlier system architectures enabled a single deployment of a PLMN to provide all features, capabilities and services required for all wanted usage scenarios.

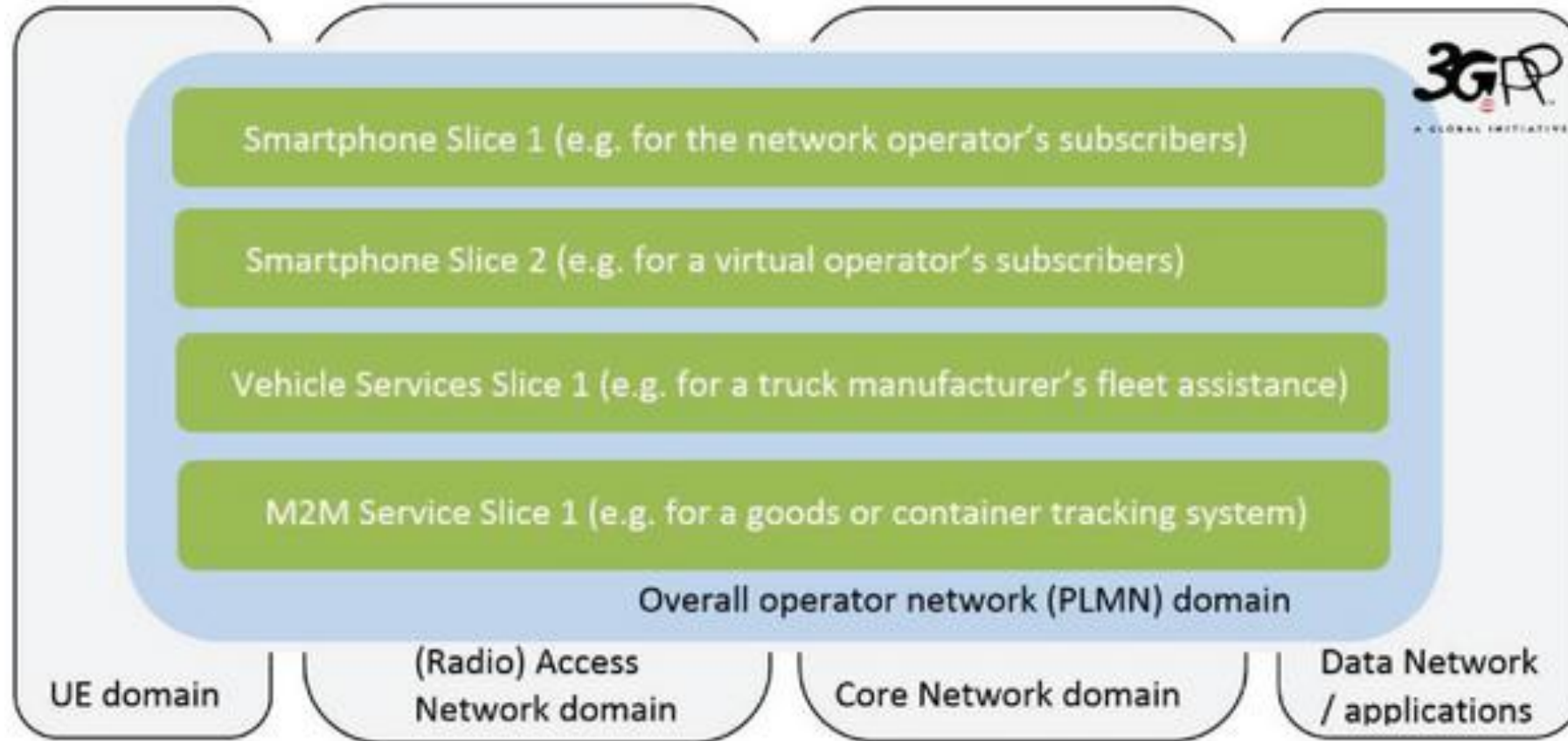
To this extent, earlier systems can be classified as a «**one-fits-all**» static network architecture.

Not all the(/few) UEs/users require the largest part of performance and functionality guaranteed by-design by earlier systems.

Network slicing enables the network operator to deploy multiple, independent PLMNs.

Thanks to the 5G architecture modularity, each sliced PLMN can be **customized** by instantiating only the features, capabilities and services to satisfy the heterogeneous requirements coming from the diverse usage scenarios.

Introduction



Introduction

The service based architecture together with softwarization and virtualization provides the agility enabling an operator to respond to customer needs quickly.

Dedicated and customized network slices can be deployed with the functions, features, availability and capacity as needed.

Typically, such deployments will be based on a service level agreement between the operator and the vertical/OTT stakeholder.

Network Slicing in a Nutshell

Network Slice is

- a logical end-to-end network
- created in an as-a-Service fashion

Different Network Slices for different services types

- committed service → Network Slice type
- dedicated customers

A Network Slice can include

- 5G Core Network
- 5G Radio Access Network
- Interworking Functions to non-3GPP Access Networks

Each 5G UE connects

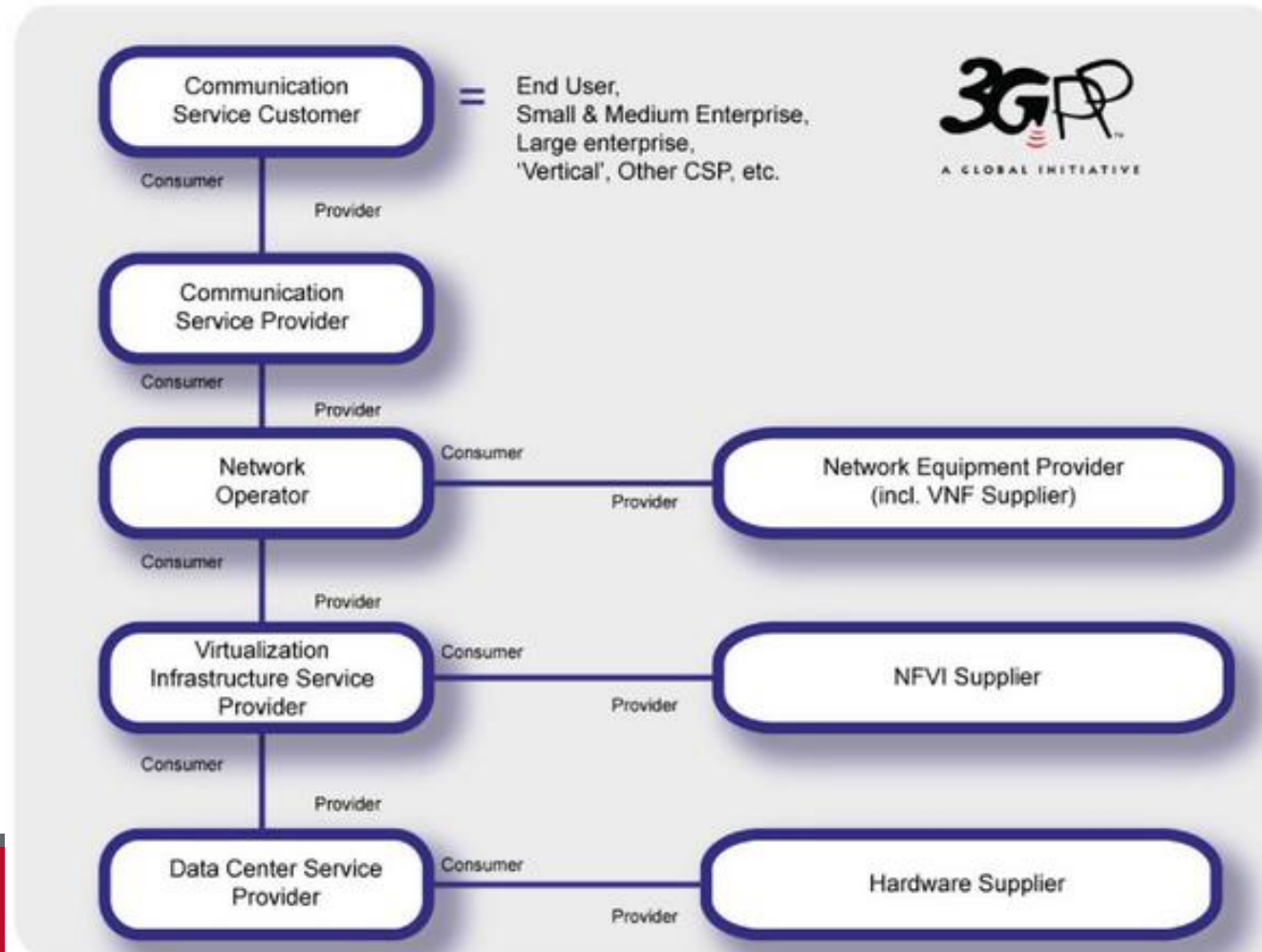
- To maximum 8 Network Slices in parallel
- A single AMF for all the slices

Network Slicing layers

The network slicing concept consists of 3 layers:

- 1. Service Instance Layer,**
- 2. Network Slice Instance Layer,** and
- 3. Resource layer** where each layer requires management functions.

5G stakeholders



Definitions

Network Slice Instance (NSI): a set of network functions and the resources for these network functions which are arranged and configured, forming a complete logical network to meet certain network characteristics.

network slice subnet instance: a set of network functions and the resources for these network functions which are arranged and configured to form a logical network.

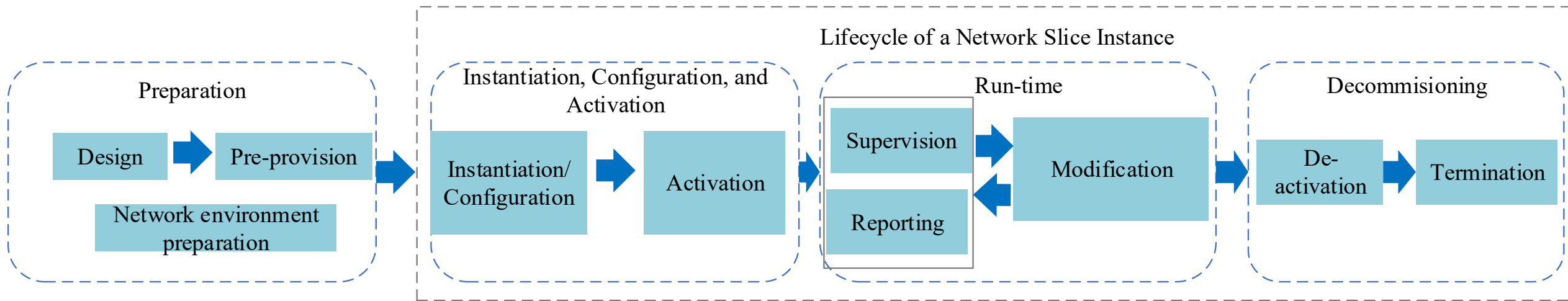
network slice subnet template: description of the structure (and contained components) and configuration of the network slice subnet.

network slice template: description of the structure (and contained components) and configuration of a network slice.

physical resource isolation: regime of resource management when a physical resource used by one network slice instance cannot be shared with another network slice instance.

Network Slice instance lifecycle

4 main phases:



Network slice base concepts

Completeness of an NSI: A network slice instance (NSI) is complete in the sense that it includes all functionalities and resources necessary to support certain set of communication services thus serving certain business purpose.

Components of an NSI: The NSI contains NFs (e.g. belonging to AN and CN). If the NFs are interconnected, the 3GPP management system contains the information relevant to connections between these NFs such as topology of connections, individual link requirements (e.g. QOS attributes), etc.

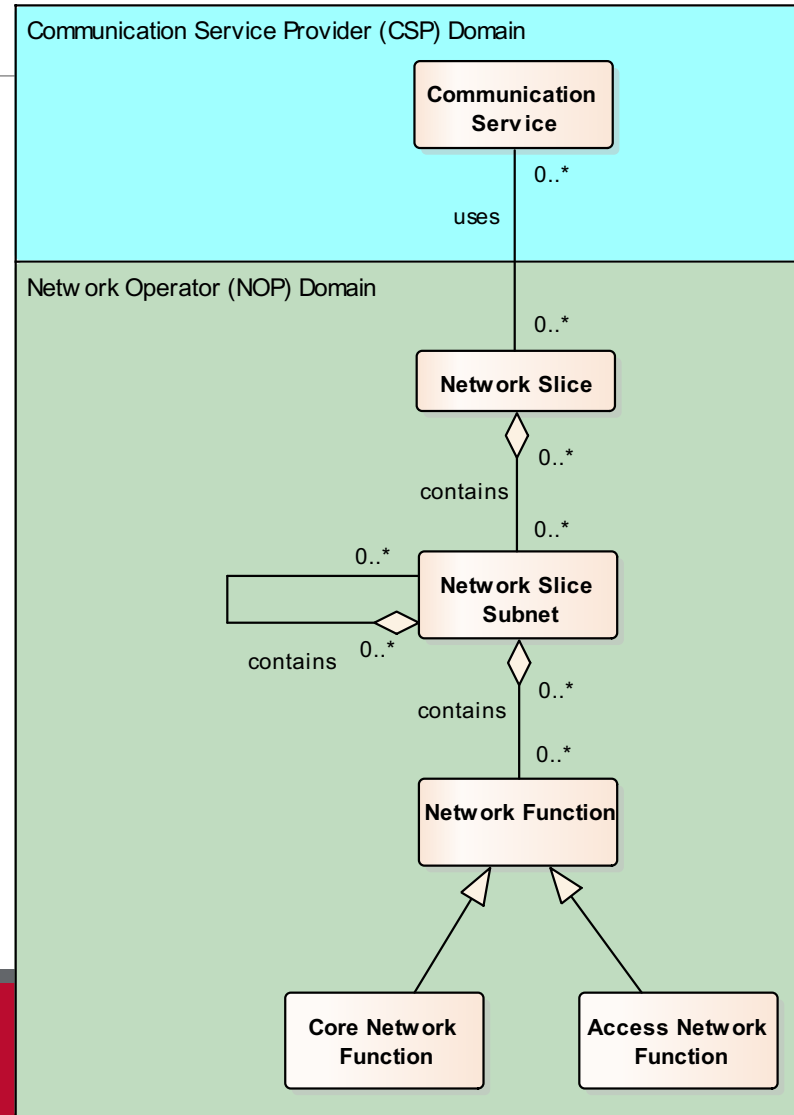
Resources used by the NSI: The NSI is realized via the required physical and logical resources.

Network Slice Template: The Network Slice is described by a Network Slice Template (NST). The Network Slice Instance is created using the NST and instance-specific information.

NSI policies and configurations: Instance-specific policies and configurations are required when creating an NSI. Network characteristics examples are ultra-low-latency, ultra-reliability, etc. NSI contains Core Network part and Access Network part.

Isolation of NSIs: An NSI may be fully or partly, logically and/or physically, isolated from another NSI.

Network Slice Information Model



Network Slice Subnet Instance (NSSI)

A network slice subnet instance (NSSI) constituent may include NF(s) and other NSSI(s).

A NSSI may be shared by two or more NSIs, this is called a shared constituent of NSI.

A NF may be shared by two or more NSSI(s), in which case it is called a shared constituent of NSSI.

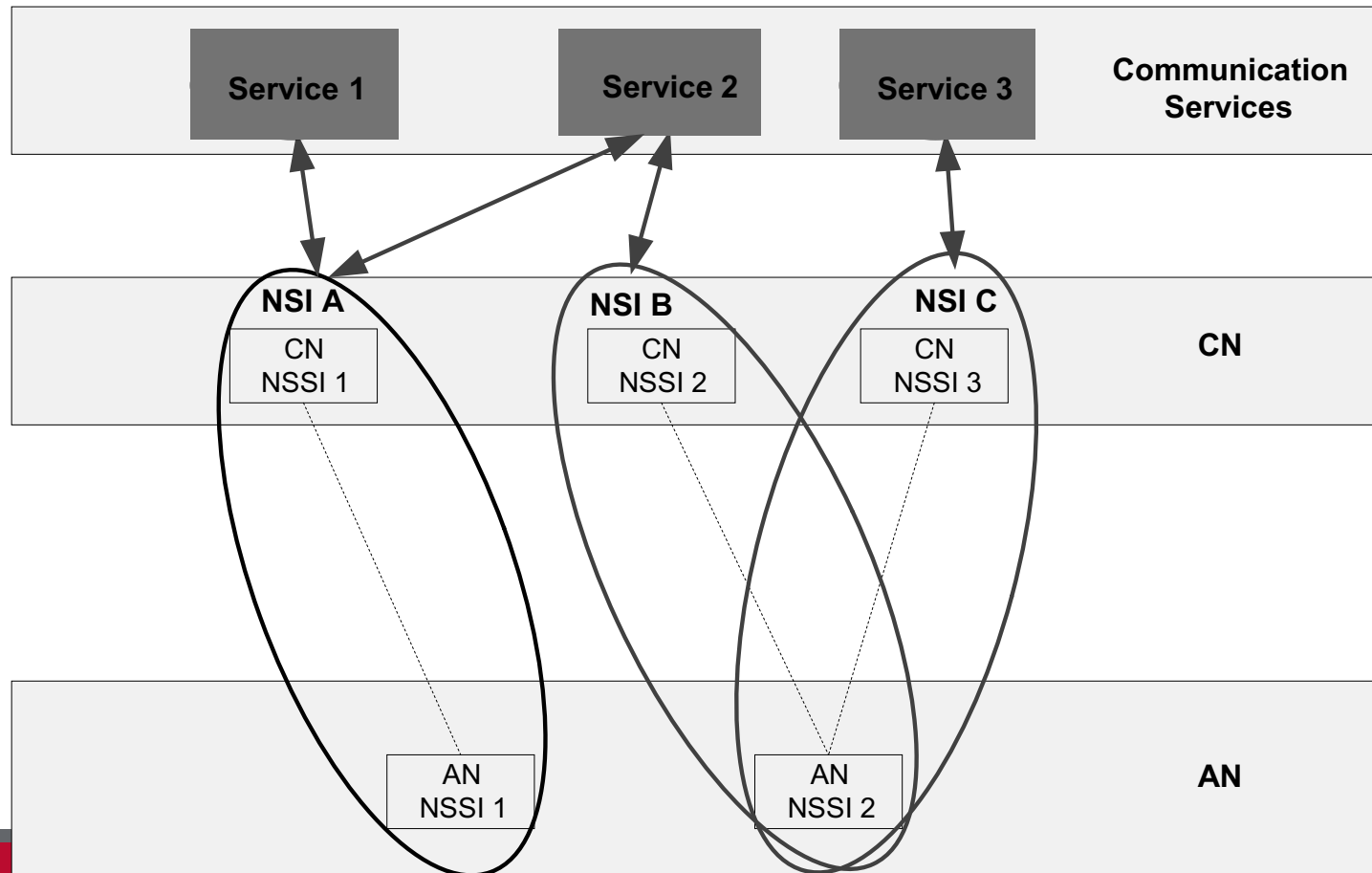
A NSSI may be shared by two or more NSSI(s), this is also called a shared constituent of NSSI.

A NSSI that is dedicated to one NSI and is not shared as a constituent by two or more NSSI(s) is called a non-shared NSSI.

An NSSI may contain CN functions only or AN functions only or both CN functions and AN functions.

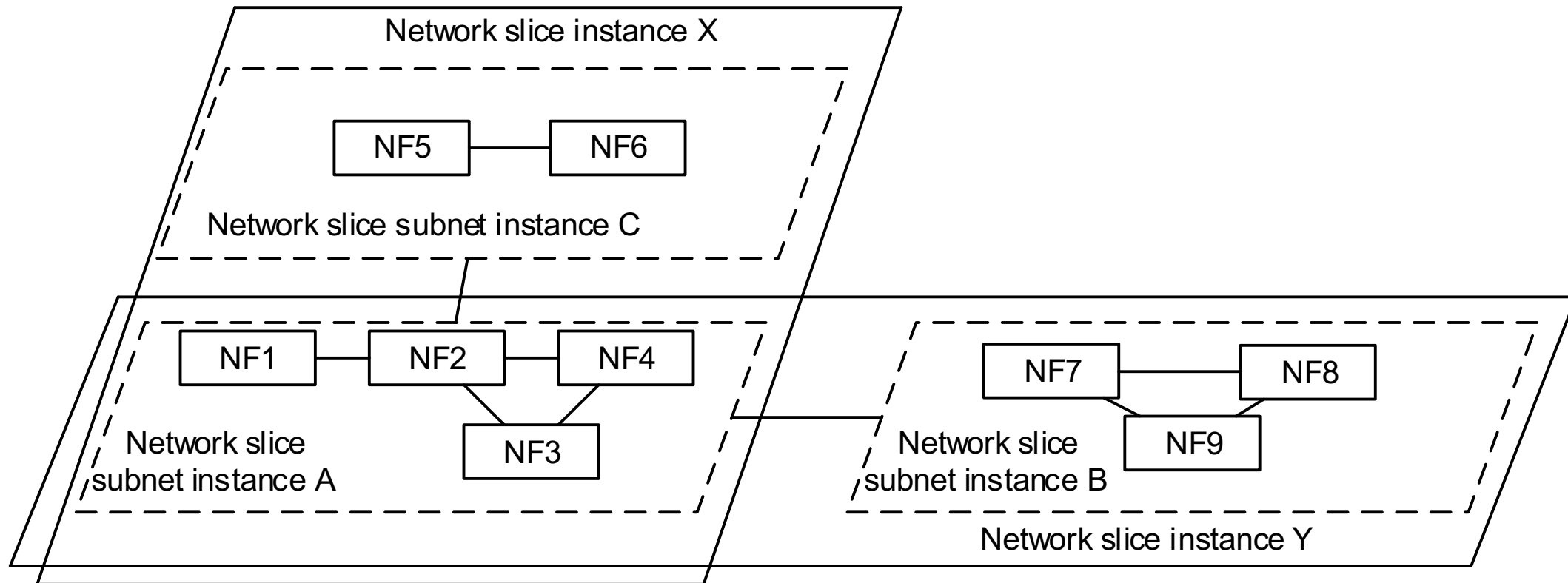
The resources comprise physical and logical resources.

Slicing example

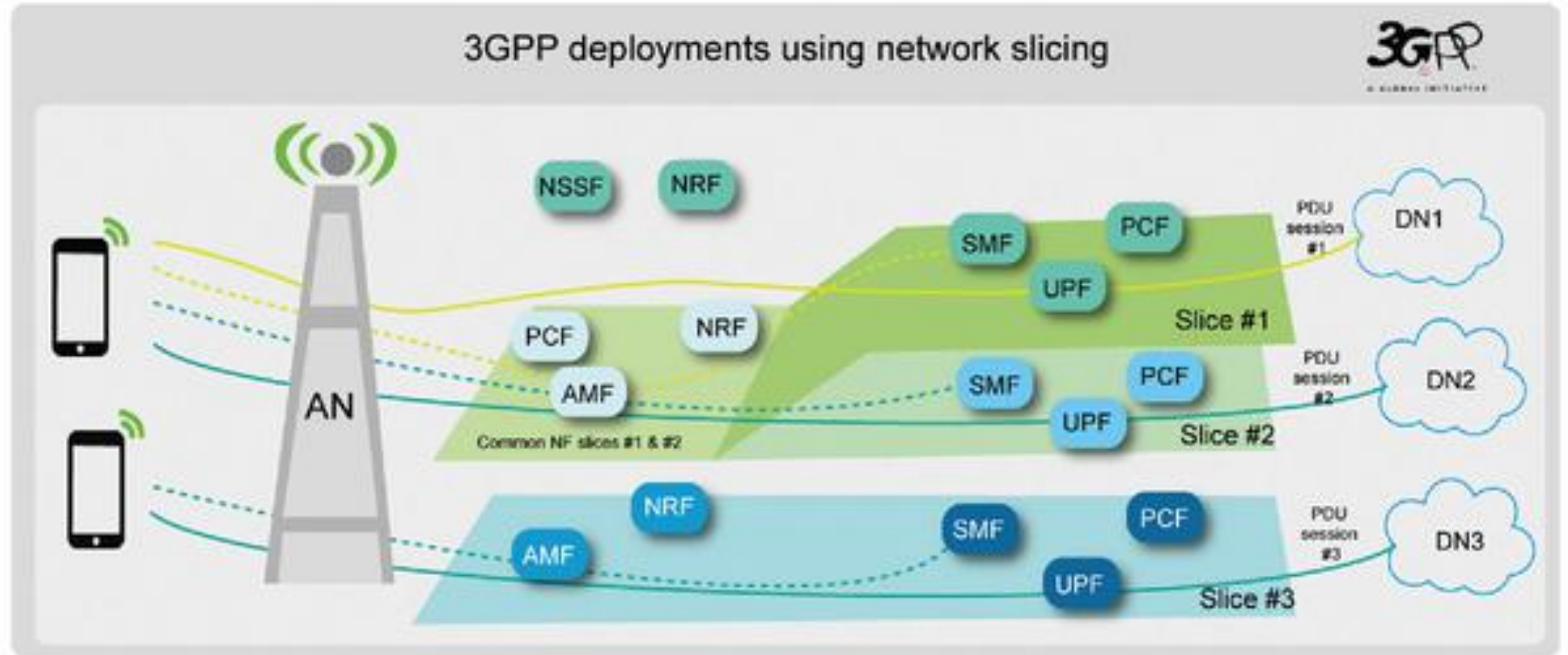


Slicing example

NSI X and Y composed by NSSI A, B and C



Slicing example



Slice Identification

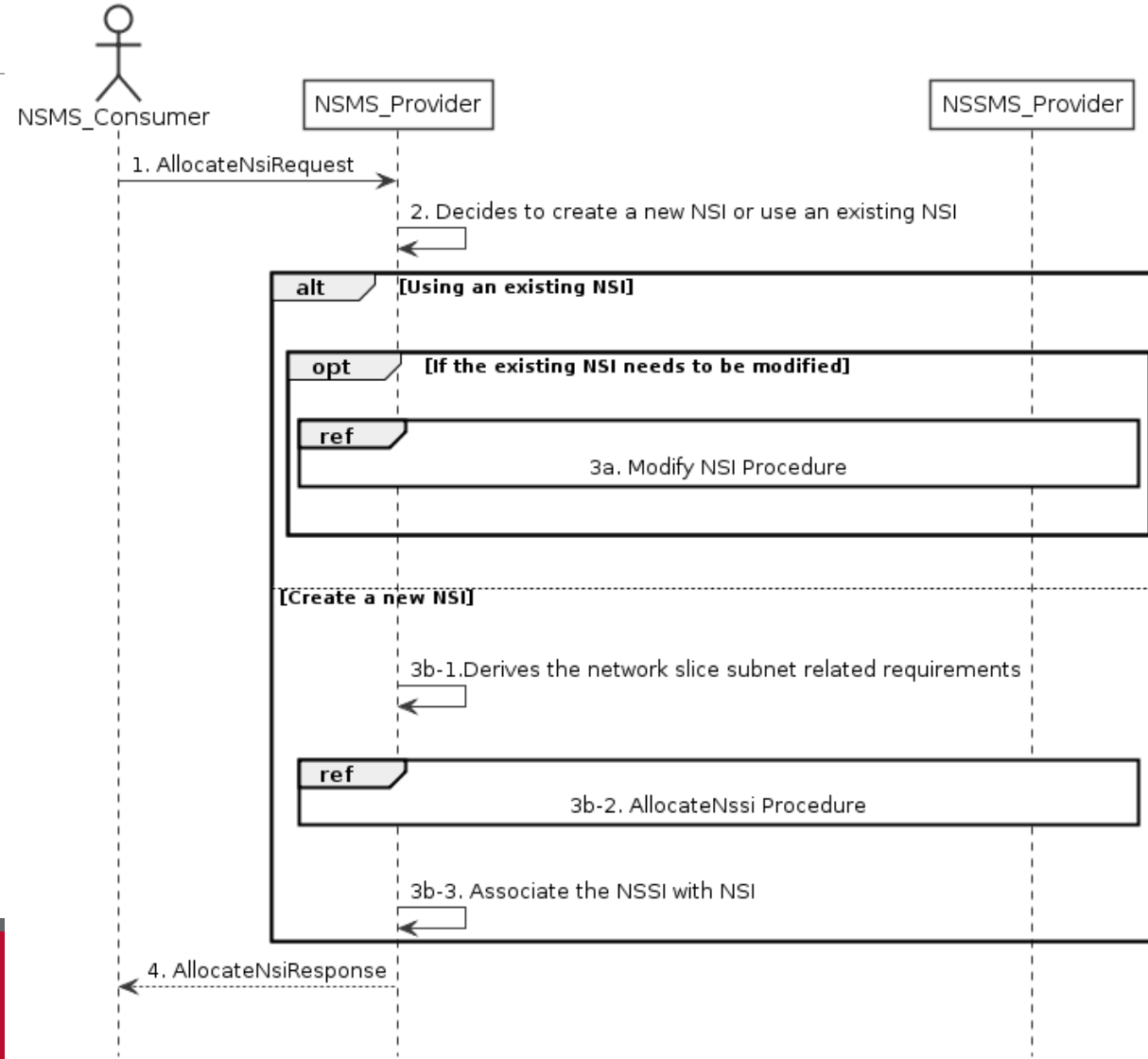
3GPP defined:

- S-NSSAI – single network slice selection assistance information
 - SST – slice type, describes expected network behavior
 - SD – slice differentiator, optional, further differentiation
- S-NSSAI can have standard or network-specific values:
 - Standard SST values: eMBB, URLCC, MIoT
- NSSAI is a collection of max 8 S-NSSAI
 - UE sends NSSAI – based on which related slice(s) are selected

Standard network slice types

Slice/Service type	SST value	Characteristics
eMBB (enhanced Mobile Broadband)	1	Slice suitable for the handling of 5G enhanced Mobile broadband, useful, but not limited to the general consumer space mobile broadband applications including streaming of High Quality Video, fast large file transfers, etc. It is expected this SST to aim at supporting High data rates and high traffic densities.
URLLC (ultra- reliable low latency communications)	2	Supporting ultra-reliable low latency communications for applications including, industrial automation, (remote) control systems, etc.
MIoT (massive IoT)	3	Allowing the support of a large number and high density of IoT devices efficiently and cost effectively.

Network Slice Instance Allocation



Procedure of reservation and checking feasibility of NSI

